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A MULTIATTRIBUTE APPROACH TO MEASURE QUALITY

OF HEALTH CARE

by

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The problem of measuring the quality of health care is one of the most evasive, yet important, problems in medical administration. Outcome measures, the ultimate validators of care, suffer from a number of drawbacks, including uncertainty and the multiplicity of possible outcome criteria. Measures of the medical decision process are easier to administer, but suffer from the lack of agreement on optimal processes for many

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20. situations. Measures of the physical or administrative structure of an organization are easiest from a data collection standpoint, but the optimal structure for quality care is not always clear. Multi-attribute utility (MAU) analysis can potentially resolve many of the issues involved in quality assurance, including the ones specifically mentioned above. In this paper the potential contributions of MAU analysis are outlined, a number of MAU studies contributing to quality measurement discussed, and suggestions for quality assurance systems made.

ABSTRACT

The problem of measuring the quality of health care is one of the most evasive, yet important, problems in medical administration. Outcome measures, measures of the medical decision process, and measures of the physical or administrative structure of an organization, the three major approaches to quality measurement, all suffer from various drawbacks. Multiattribute utility (MAU) analysis can potentially resolve many of the issues involved in quality assurance. In this paper the potential contributions of MAU analysis are outlined, a number of MAU studies contributing to quality measurement discussed, and suggestions for quality assurance systems made.

A MULTIATTRIBUTE UTILITY APPROACH TO MEASURE QUALITY OF HEALTH CARE

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A MULTIATTRIBUTE UTILITY APPROACH TO MEASURE QUALITY OF HEALTH CARE

The need to develop a useful measure of the quality of medical care has become increasingly important in recent years. A number of reasons for this need can be cited, including the necessity of determining the quality of care delivered by innovative medical care systems, the increased interest in and use of paramedical professionals in delivering care, the need to control medical costs without sacrificing quality, the increasing role of third parties in paying the costs of medical care, and the need to certify institutions engaged in medical care delivery. The problem of how to measure quality of care, however, is an elusive one. Quality measurement requires one to compare multiple effectiveness criteria, to do so consistently, and to do so in an uncertain, complex enviornment. These considerations suggest the potential usefulness of multiattribute utility (MAU) analysis in deriving quality standards. Before discussing specifically the manner in which MAU analysis could contribute to this area, a brief summary of the capacities of MAU analysis is given, then some of the problems involved in defining and measuring quality of care are discussed. The potential role of MAU analysis in attacking some of these issues is indicated. Finally, a suggested quality measurement system is outlined.

I. Summary of MAU Analysis

The term MAU Analysis, as used in this paper, refers to the normative system of decision analysis as expounded in a number of sources, among them Raiffa[1], North[2], Schlaifer[3], and Brown et al[4], together with the results of multiattribute utility theory as discussed by Keeney[5,6,7,8],

Fishburn[9,10,11], Fishburn and Keeney[12], and Farquhar[13], among others. In essence, multiattribute utility theoretic results allow one, given certain assumptions concerning one's utility structure, to develop and express a utility function over multiple attributes. This results in the development of a single measure of "goodness" which summarizes multiple, possibly conflicting, measures. Further, as first indicated by Von Neumann and Morgenstern[14], the expected value of such a utility function can be used as a decision criterion under uncertainty. Decision analytic techniques then indicate how even complex decision problems can be structured and analyzed, using a utility function to guide the analysis. Final results can include not only optimal decision strategies, but such data as the value of additional information and the sensitivity of results to analytical inputs.

II. Defining and Measuring Quality of Medical Care

With this preliminary summary of the analytic tools completed, let us turn to the problem at hand, measuring the quality of medical care. Defining "quality of medical care" is itself a task of remarkable difficulty. Donabedian[15] points out that in practice quality can be almost anything anyone wishes it to be, thus any discussion of the subject is potentially plagued with misunderstanding. "Quality of care" is clearly not a unitary concept but a composite of many, sometimes conflicting, desiderata which must be simultaneously considered. There is agreement on some of the factors that go into quality --- success of the care in preserving or restoring health, efficiency in the use of resources, prevention and alleviation of physical and psychological suffering --- but there is wide disagreement on how inclusive such a list of factors should be and how much emphasis is due each of the aspects. We might examine

this issue by considering first measures of quality of care for an individual, then discussing the issues involved in extending these concepts to groups or societies.

Quality Measurement for Individuals

For an individual the delivery of medical care can be thought of as affecting, in a probabilistic sense, the health, psychological, and financial outcomes experienced by the person. A number of these outcomes are quantifiable, such as morbidity, mortality, amount of money expended on health-related items, freedom from pain and discomfort, even degree of freedom from psychological stress. For individuals then, the ultimate validators of quality exist in more or less accessible form, although in embarrassing richness. When trying to use outcomes to measure quality one must resolve a number of issues. First, which outcome measures are to be used, and how are they to be combined? In treating patients with certain chronic disabilities, for example, treatment strategies can depend strongly on whether one considers morbitity or mortality of primary importance. Second, even if one succeeds in devising a satisfactory unitary measure, the uncertainty and complexity of medical processes make it difficult to determine an optimal strategy for delivering care. Third, even if an optimal strategy were available, the diagnostic skills, treatment skills, patient management skills, even the mechanical skills (e.g. how quickly and easily can a hypodermic needle be inserted) of the medical practitioners involved in the delivery system can have a great impact on the outcomes. Thus, a standard of comparison is required against which actual outcomes can be measured. Ideally the standard would be quantitative, would control for the preexisting condition of the patient, and would allow for the inherent uncertainty in any medical intervention. A final problem with any quality control

system which depends on outcome measures is the time delay often required for some outcomes to become manifest. The success of some treatments is not fully known until years have passed.

MAU analysis offers the capacity of dealing with some of these issues. The issue of determining which outcome measures are to be used and the way in which they are to be combined can be resolved by assessing a utility function over those outcome measures the person considers relevant. The practicality of this approach has been demonstrated in a number of studies. Giauque and Peebles[16], in analyzing streptococcal sore throat and rheumatic fever, assessed a utility function over ten measures, including cost factors, the number of days ill with streptococcal infection, severity of antibiotic reactions if any, and the existence and severity of acute rheumatic fever and chronic rheumatic heart disease. Krischer[17], in analyzing patient management decisions for cleft palate, assessed utility functions over such "nonquantifiable" factors as the degree of speech and hearing impediment and the degree of disfigurement remaining after treatment, as well as the cost of the treatment. Kapernick[18] assessed a utility function over costs, various degrees of illness and inconvenience, reduction in longevity, and the possibility of death in analyzing hypertension. Ginsberg and Offensend[19] assess utilities in analyzing a particular case of back pain, although they determine utilities directly for a limited number of outcomes rather than specifically assessing a multiattribute utility function. This approach is somewhat simpler than the multiattribute approach, but is limited in that only a small number of specific outcomes can be considered.

A potential problem which is not totally resolved by MAU techniques is that of whose utility function should guide the treatment of a patient. Clearly the patient

himself should be the primary choice, but there are situations where a patient's preferences may need to be subordinated to an overall societal need, for example in imposing a quarantine. This issue may be of more theoretical than practical importance if all persons involved have utility structures implying identical courses of action. In the studies by Giauque and Peebles[16] and Krischer[17] this was indeed the case. Giauque and Peebles reported that utilities assessed from patients, doctors, nurse practitioners, and public health officials varied from individual to individual but not in any systematic way from group to group, and that in any case the solution was so robust as to give identical optimal strategies for each assessor. Krischer reported that the utilities assessed by all respondants to a questionnaire were very close to each other. However one cannot always count on results being this fortuitous. In case of conflicting strategies, one solution would be to choose that which maximizes the group utility of the entire society. In the case of quarantine, for example, the disutility of the quarantine for the individual must be compared to the utility of disease avoidance by the remaining population. This general issue is discussed further in the next section of this paper.

The problem of determining optimal strategies for delivering care can also be attacked through MAU Analysis. Each of the studies cited above was decision oriented, in that the optimal strategies for administering diagnostic and treatment procedures were determined. A number of additional decision analytic studies of medical problems could also be cited. Ginsberg[20] analyzed the pleural-effusion syndrome, expounding in addition a general analytic framework for medical analysis. Lusted[21], Jacquez[22], Gorry[23,24], and Gorry and Barnett[25] discuss diagnostic approaches utilizing concepts of decision theory, while Betaque and Gorry[26], Schwartz et al[27], and Gorry et

al[28] discuss additional concepts in medical decision analysis. Krischer[17] (Section 1.2) contains a useful summary of many of these papers. Giauque[29] contains a summary of decision analytic studies in non-medical, as well as medical areas. Thus the feasibility of using decision analytic techniques to structure and resolve complex, uncertain problems has been demonstrated, but there remains the issue of practicality, determining whether an analysis is worth the not inconsequential time and trouble it takes to carry it out. Often the analysis would not be worthwhile for a single individual, but may be justified if the results could be applied to entire groups of patients. Most of the studies cited above were indeed intended to apply to most or all patients falling within certain classes. In some of the studies an attempt was made to identify those patient characteristics which would affect the derived optimal strategy. Giauque and Peebles[16] for example examined the effects of patient age, days since onset of the symptomatic streptococcal infection, and prior history of penicillin reactions. Kapernick[18] controlled for patient age and general patient health. Such studies can be considered preliminary attempts to establish decision standards which are controlled for the preexisting condition of the patient, but clearly a good deal more needs to be done before definitive standards can be said to exist.

The third issue, establishing outcome standards to control for practitioner skill, cannot be done on an individual patient basis due to the stochastic nature of the medical process. Just as good decisions do not guarantee good outcomes, so good procedures administered with the utmost skill, even when combined with good decisions, cannot guarantee good outcomes. The MAU Analytic techniques discussed above do, however, establish average occurrence rates for various outcomes. These data could potentially be used as a basis for a control system, but this would have to

be over many patients, rather than for an individual case. In addition, the optimal strategies can themselves serve as standards, but as process standards rather than outcome standards. Process measurement offers a number of advantages over outcome measurement. First, results of process measurement are available relatively soon, immediately following the care delivery if necessary. Second, process measurement attempts to directly assess the quality of the decisions made, thus allowing one a standard which does not involve uncertainty. The uncertainty regarding outcomes is automatically accounted for in setting the standard. Finally, many process measurements are concrete, either in terms of whether or not a particular service was performed in an individual case, or in terms of statistical measures, such as the proportion of the population reached, the volume of services rendered, and the costs of service. Many suggested quality control techniques are built around process measures. Forst[30] suggests using process standards constructed by MAU analysis in determining settlements in malpractice suits. Flagle[31] suggests nine measures of process of care, covering the areas of inclusiveness, adequacy of content, and productivity. Donabedian[32] contains an extensive discussion of the issues involved in process measurement, many of which relate to the practicality of a measurement system for large groups. This leads us into a consideration of issues involved in quality measurement for groups and societies.

Quality Measurement for Groups

Suppose we have successfully assessed utilities from and determined optimal treatment strategies for each member of a particular group, and we are now faced with decisions which may affect all members of the group. Decisions concerning care can still be made for each member of the

group individually, but these individual decisions are constrained by, and in some cases guided by, group decisions. The design of the delivery system, for example, can limit access to even basic medical care by some parts of the population. A societal decision to extend the availability of basic care through say a system of low cost neighborhood clinics might result in better care for some people, but one might legitimately ask whether this would result in higher overall quality than building, for example, a dialysis unit for those with kidney disease. In either case the failure of the group to provide certain resources may effectively limit the options open to the individuals. We are now faced with the problem of determining a so-called social welfare function, a measure which summarizes the welfare, or utility, of the group as a whole. If such a function could be found then our choice of group action could be guided by it, but there are some difficult theoretic and practical problems involved. Kirkwood[33] Chap. II contains a summary of these issues. Briefly, it is possible to define a social welfare function, given the utilities for each member of the group, but only if some restrictions are met. Perhaps the most convenient form is that given by Harsanyi[34], which gives the group utility of any alternative as the weighted sum of the utilities of each individual for the alternative. Required conditions are that both the group utility and the individual utilities obey the von Neumann - Morgenstern axioms of cardinal utility or their equivalent, and that if two situations are indifferent from the standpoint of all individuals, then they are indifferent for the group as a whole. Kirkwood[33] generalizes these results by applying the concepts of pairwise preferential independence and mutual utility independence, as discussed in Keeney[5,6,7,8], to group utility structures. The more general formulations developed by Kirkwood also construct the group utility function by multiplying the individual utilities by weighting constants,

then adding and/or multiplying the weighted utilities. Assuming these formulations give reasonable approximations in real conditions, one must only assign weights to each individual, in effect determining whose preferences should count the most, to get the group utility function. Giving each person in the group an equal weight is one obvious possibility, although this raises some interesting questions (should more weight be given to those who give the greatest financial support to the system, should age or general health affect weights, how should preferences of persons who deliver the care be accounted for, etc.).

Given the possibilities of this methodology in determining optimal strategies for the group, the practical problem remains of how to set up a quality control system which exploits them. As in the case of individual quality control the outcomes experienced by the group can be used to measure the overall effectiveness of a system, with the significant advantage that uncertainty, in a large sample, can be at least partially accounted for. Average occurrence rates, determined by the optimal strategies chosen, can serve as quality standards. However, the other major difficulty with outcome measures, the time delay often occurring between treatment and the final observation of all outcomes, still remains. Even if the delay is not excessive there are formidable problems in gathering data on all pertinent outcomes, especially once the patient leaves the site. We can, though, use process standards to determine the quality at least of the decision making, though perhaps not the skill of the practitioners in performing the processes.

Donabedian[32], in his extensive discussion of process standards, points out that if we attempt to define standards for every possible situation, even allowing the possibility of setting meaningful standards, we would become hopelessly

bogged down in endless detail. Clearly we cannot hope to predefine optimal actions for each possible problem for each possible patient. However, we can determine, for those medical problems which are important, where uncertainty exists concerning which among significantly different courses of action is best, the relative desirabilities of different strategies, and determine the sensitivity of the choice of strategy to patient characteristics. Thus, critical factors are identified, allowing the practitioner to focus his attention and use his judgment on relative well defined issues. In addition, retrospective analysis can be used for quality control after the fact, either in medical audits or in lawsuits, as suggested by Forst[30].

The mechanical and administrative problems of designing an ongoing, systematic quality assessment program remain formidable. Supposing that outcome and/or process standards exist for at least some areas, how are the data measuring actual outcomes and processes to be collected? Overall statistics on some outcome measures, such as mortality, are sometimes available, but data on other measures may be completely lacking. Patient records are generally sketchy, incomplete, and difficult to access. Recollections of patients and practitioners are subject to bias, inaccuracies, and incompleteness, while medical practitioners, particularly physicians, are loth to be too critical of colleagues. The mechanisms for conducting process reviews also lead to problems. Case reviews are expensive and suffer from the lack of good source data. Direct observation of a practitioner's activities is also expensive and is apt to change the practitioner's behavior. In addition, the observer may not know as much as the practitioner in some areas, particularly concerning patient histories, thus possibly leading to inaccurate judgments. Statistical indices, are easy to review, but may be difficult to collect, to identify with a particular system

of care, and to control for patient characteristics. For these reasons, structural measures usually supplement outcome measures and process measures in quality assessment.

Structure measures examine the physical, professional, and operational structures of institutions in which medical care takes place. As defined by Donabedian[15], structure measures are "concerned with such things as the adequacy of facilities and equipment, the qualifications of medical staff and their organization; the administrative structure and operations of programs and institutions providing care; fiscal organization and the like." Structure measures can be relative easily and cheaply made, and the results are available quickly. In addition, they are fairly concrete, at least in part, thus are more amenable to control through guidelines and legislation than other measures. The major drawback of structure measures is the rather tenuous connection between structure and outcome. There are some instances where a connection can be drawn; if certain processes can be identified as desirable in treating a given disease and if those processes require certain types of training or equipment, then clearly the presence of that equipment or of adequately trained personnel is a necessary, though not sufficient, condition to good quality care. Even in this case, however, the actual delivery of high quality care is not assured. In more general situations, there can be significant differences of opinion concerning the contributions of various structural measures to the qulaity of care.

III. Suggested Quality Control Systems

The setting in which medical care is being delivered has a great impact on the feasible mechanisms for administering a quality control system. In this section we will discuss three types of setting, a large controlled group, a small informal group or private practice, and quasi-medical institutions. There are, of course, other possibilities, but these three will suffice to illustrate the major issues.

Large Controlled Groups

A large controlled group is typified by many military health care organizations, as well as by some large civilian group or public health practices. The major characteristic of such groups is the existence of a recognized authority or chain of authority in administrative matters, and at least to some extent in medical matters. Such organizations serve sizable populations and usually, though not always, individual relationships between the patient and the health practitioner are not strong. This creates a need (not always fulfilled) for a good patient record system, while the existence of the central authority provides the means to design and implement such a system. Further, the size of such groups makes innovative methods of health care delivery both possible and important, and the need to evaluate the resulting quality of care is especially acute. For such settings, separate levels of quality control based on outcome measures, process measures, and structure measures are suggested. First, outcome data can be collected through the patient record system. To minimize the difficulties caused by the time lag between treatment and the observation of outcomes, "indicator" presenting symptom complexes could be selected and statistics on the outcomes for patients with

those presenting symptoms gathered. The indicator symptom complexes should be such that outcomes could be observed within a fairly short time, and should be common enough to allow reasonable sample sizes for each practitioner. The term "symptom complex", incidently, is used in place of "disease" since the patient presents a complex of symptoms to the medical system, and determining the cause of the symptoms, the disease, is part of the diagnostic problem. Some possible symptom complexes are[35] headache, lower back pain, constipation, and obesity. For each symptom complex chosen, MAU analysis could be used to determine which diagnostic/treatment processes are optimal, to examine the effects of patient characteristics upon optimal treatment choices and expected outcomes, to establish the expected frequency of various outcomes, and to determine what outcome data should be collected.

The second type of quality control appropriate in large controlled institutions is process control. As discussed earlier in this paper, MAU analysis can lead to process standards for a number of symptom complexes. In an institution of this sort process control can be implemented through reexamination of selected patients, by patient interviews, and through patient record audits. Again the MAU analysis would indicate the data that should be captured on patient records in order to make the audits complete. Flagle[31], in discussing process standards, suggests nine criteria, namely

Measures of inclusiveness;
- proportion of the population reached,
- proportion of health problems covered,

Measures of content;
- completeness of services,
- rationality of services,
- responsiveness of services,
- humaneness of services,

Measures of productivity;
volume of services rendered,
health productivity, and
costs of service.

The discussion above directly addresses issues in the areas of completeness and rationality of services, but the MAU techniques could just as easily be used to determine, for example, appropriate levels of inclusiveness.

The third level of control, based on structure measures, can be applied by ensuring that the capability for good quality care exists, in that appropriate equipment for the desired procedures is available and personnel are able to carry out the procedures. MAU analysis can both indicate what the optimal procedures are, and quantify the degree of quality given up if less that optimal facilities are available.

Small Informal Group or Private Practice

Problems of quality control in this setting are extremely difficult, as indicated by the literature (c.f. Donabedian[15,32], Flagle[31]). Major issues are the lack of objective, complete data on patient symptoms, treatments, and outcomes, the difficulty of accessing what patient data is available, the lack of any person or group with the recognized authority to make quality judgments concerning private practices, and a long tradition against meddling with a physician's "private" affairs. It would clearly be very difficult to gather outcome data for such practices, but one might reasonably hope to utilize some types of process control. It seems reasonable, for example, to contuct "patient audits" from time to time. A sample of patients, either chosen randomly or selected by specific symptom complexes, could be interviewed, and the

test-treatment sequence reconstructed through patient records and the recollections of the patient and the physician. This of course would require a change in attitude on the part of many physicians. Measures based on structure would be much easier to construct and would give an indication of at least the potential for good quality care. Certification and recertification examinations and continuing education requirements can be and are being used to insure technical competence, while checklists of required laboratory facilities, medical instrumentation, examination facilities, and office procedures can insure an adequate physical and administrative enviornment.

Certification of Quasi-Medical Institutions

There is currently a need for medical certification procedures for such quasi-medical institutions as nursing homes, rest homes, sanatoriums, and the like. In terms of controllability, such institutions fall between large groups and private practices. The right of an authority, usually the state, to examine and question medical standards is recognized, but the direct authority evident in, say, a military medical facility is lacking. In these situations, quality standards based on structure measures are certainly appropriate and feasible. If an institution requests certification to admit and treat a certain type of patient, clearly the physical facilities and medical staff required for quality treatment would have to be available. The major questions here generally pertain to the degree of capability required. Is it necessary to have a full time physician in a nursing home, or is it sufficient to have one available on call? Need regular physical examinations be provided? How often? Is a nurse able to deliver quality care in this setting, or a physician's assistant, or is a physician required? MAU analysis offers the capability of examining

any number of such questions.

Process measures can be made more effective in institutional than private practices since the state can reasonably impose standards of patient record keeping, and can reserve the right to conduct patient audits from time to time. In institutions most patients are physically available for extended periods, so it becomes feasible to conduct independent medical examinations. Finally the extended nature of institutional care allows for the gathering of some outcome data. If cure rates, length of stay, or other outcome measures for a particular institution are abnormal, a more intensive investigation, such as a patient audit, could be conducted.

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